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Wire-stripping plier with automatic adaptation to various wire gauges

The invention relates to a wire-stripping plier with an automatic adaptation to various wire gauges and insulation thicknesses with two pairs of pivotable jaws of which the jaws of a first, outer pair are configured as gripper jaws and that are pivotable by means of a first jaw arm and a jaw part about a common point, and the jaws of the other, inner pair that are configured as cutting jaws with blades that cut into the insulation, and with a pull rod attached to the cutter jaws and longitudinally moveable within the jaw body providing the stripping motion that is coupled with a second plier arm.

There are many pliers and similar hand tools used to strip the insulation from electric cables. Compared with traditional cable cutters, adjustable or pre-set wire-stripping pliers offer higher safety for the user and for the cable material. In order to maintain a high-quality connection, it must be ensured that the electrical conductor (single or multi) remains undamaged during stripping. For this, the most important issue is that the sheathing at the end of the cable, and of the individual conductors, may be removed in the contact area cleanly and at the proper length. The great advantage of a conventional automatic wire-stripping plier is the option of pre-cutting and then stripping the insulation in one step by means of further compression of the plier handgrips. Adaptation to varying insulation and cable thicknesses had to be achieved via manual adjustment of the plier, or by provision of multiple blades of varying shapes. Improper operation or adjustment always presented a hazard of conductor damage.

For example, DE 44 20 006 A1 describes a plier to strip conductor ends with an outer pair of holding jaws and inner pair of cutting jaws. Limited adaptation to the wire gauge is achieved by means of the resistance that the holding jaws encounter when compressed. For cables of very small gauge, the compression is limited by an additional limiter. However, adaptation to varying thicknesses of insulation materials was not possible. The danger arises that hard insulation is cut too shallowly, or soft insulation is cut too deep. The result may be that irregularities arise to the cable to be stripped, or to an individual conductor.

EP 0 645 861 A2 describes a stripping plier with two pair of pivotable jaws from which the jaws of the outer pair are implemented as gripper jaws and the jaws of the other, inner pair are implemented as cutter jaws with blades that cut into the insulation. Adaptation to varying conductor gauges and insulation thicknesses is enabled via a cam. By rotating the cam, the user may alter the position the lower cutter jaw and thereby that of the corresponding cutter blade.

DE 44 20 050 C1 describes a wire-stripping plier in which at least one cutter jaw includes a packet of adjacent strips with cutter edges moveable perpendicular to the jaws longitudinal direction that, when the plier is closed, press into the insulation. The strips are supported by means of a clamp arm with a V-shaped recess. Adaptation to varying conductor gauges is performed in that the recess is narrower or wider. To strip conductors of varying gauges, it is necessary to provide clamp arms with varying recesses that must be selected by the user and inserted into the wire-stripping plier.

It is the task of this invention to improve a wire-stripping plier so that automatic adaptation of cutting depth is simply achieved for varying wire gauges, insulation thickness, and insulation material.

This task is solved by the wire-stripping plier based on the invention in which at least one sliding wedge is mounted in a recess of the first plier arm matching the shape of the sliding wedge, whereby a sliding-wedge surface facing the cutter jaws is flat and a second sliding wedge resting within the recess is so shaped that the separation between both sliding wedges diminishes from a central area of the sliding wedge toward at least one of the two sliding wedge ends. When the wire-stripping plier is opened, the sliding wedge is displaced longitudinally with simultaneous matching of position of the sliding wedge perpendicular to the longitudinal direction that results in cutting-depth adjustment of the cutting jaws and the cutting blade attached to it.

Use of such a sliding wedge enables simple adjustment of the cutter jaws to match the cut depth into the insulation. Depending on whether a matching sliding wedge is in the first plier arm, the jaw part, or in both elements, either one or both cutter jaws is adjustable.

Proper shaping of the second sliding wedge mounted in the recess of the first plier arm or jaw part enables manufacturer-side basic matching to the cutter depths required for varying insulation materials.

The wire-stripping plier based on the invention provides automatic adaptation of the cutter-jaw cut depth for wire gauges within the range of about  $0.5 \text{ mm}^2$  to  $10 \text{ mm}^2$ .

Based on a particularly advantageous embodiment of the invention, a first sliding wedge in a recess of the first plier arm and a second sliding wedge of the same shape within a recess of the jaw part. A bowed shape has proved particularly suitable for the second surfaces of the sliding wedge. This includes a diminishing of the separation between the two sliding wedges. In this embodiment example, both cutter jaws have adjustable depth, whereby a clean cut from all sides is ensured. In varying embodiment examples, the second surfaces may also possess a different progression, e.g., oblique to the plane the first sliding wedge so that a sliding wedge that is wedge-shaped only on one side results.

It is useful if, in another embodiment example, the side of the cutter jaws facing the sliding wedge include a first and a second projection. The first projection provides a point-type positioning of the cutter jaw on the sliding-wedge surface. Since only such positioning exists between cutter jaws and sliding wedge and not a full positioning, the friction of the cutter jaws on the sliding wedges is minimized, thus ensuring smooth displacement of the sliding wedges.

Based on another embodiment example, the gripper jaws each possess a raised gripper tooth, preferably on the end of the gripper jaw facing the cutter jaw. The raised gripper tooth and the cutter blade include mirror-image cutter steps. When the plier is closed, the raised gripper tooth cuts slightly into the cable, whereby additional positioning of the insulation remaining on the cable is achieved.

In another useful embodiment of the invention, a slight longitudinal displacement of the sliding-wedge surfaces with respect to each other is achieved by the shape of the second surface. This causes a slight opening of the plier jaws as the cutter jaws move. This can

compensate for irregularities in the cable to be stripped, thus preventing damage to the conductors.

It is further advantageous to attach the cutter blades to the cutter jaws so that they may be removed. The cutter blades are preferably screwed onto the front sides of the cutter jaws facing the gripper jaws. Thus, they may be easily replaced when worn, or replaced by other cutter blades suited to the application. The use of shaped blades is also conceivable when harder insulation materials such as Teflon is to be processed.

The gripper jaws are preferably mounted in receiver jaws so that they may be removed. These jaws may also be simply exchanged in case of wear. Additionally, the height of the gripper jaws may be adjusted, whereby adaptation of the impression depth is possible.

Further advantages, details, and embodiments are provided in the following description of an advantageous embodiment of the wire-stripping plier with reference to the Figures, which show:

- Fig. 1 an overall view of a wire-stripping plier based on the invention with opened jaws;
- Fig. 2 an overall view of a wire-stripping plier based on the invention with closed jaws;
- Fig. 3 a principle drawing of the longitudinal displacement of a sliding wedge;
- Fig. 4 a detailed view of the plier jaws;
- Fig. 5 a detailed view of gripper jaws with receiver jaws;
- Fig. 6 a detailed view of the sliding wedge with positional securing.

Figure 1 shows a wire-stripping plier based on the invention with opened jaws in an overall view. The wire-stripping plier includes a first plier arm 1 and a jaw part 3, which possess a common pivot point 5. A second plier arm 7 that is connected via a lever pivot axis 8 with the first plier arm acts via a link 9 with a roller 11 on the jaw part 3 so that the plier jaws are also closed by a closing movement of the plier arms.

A first sliding wedge 13 with a sliding-wedge surface 15 facing the plier jaw opening is located in a recess in the first plier arm, and a second surface 17 is also in the recess. The first sliding wedge 13 is connected with the jaw part 3 via a first coupling rod. A first pin 21 serves to secure the first coupling rod 19 in the jaw part 3.

A second sliding wedge 23 is mounted within a recess in the jaw part 3. It possesses a sliding-wedge surface 25 facing the plier jaw opening and a second surface 27 in the recess.

The second sliding wedge 23 is connected with the first plier arm via a second coupling rod 23. a second pin 31 serves to provide a firm seat for the second coupling rod 29 in the first plier arm.

The sliding-wedge surfaces 15, 25 facing the jaw opening are flat. The second surfaces 17, 27 lying in the recess are preferably so shaped that the separation between the first and second sliding wedges 15, 17 or 25, 27 diminishes uniformly from a central area of the sliding wedge 13, 23 toward both ends of the sliding wedges 13, 23.

A bowed shape has proved to be particularly advantageous. The recesses serving to store the sliding wedges 13, 23 match the shape of the sliding wedges 13, 23, and also possess a arc-shaped contact area matching the second surfaces.

The wire-stripping plier is further equipped with two pairs of pivotable jaws. The jaws of the first, outer pair are implemented as gripper jaws 33, and are moveable with the first plier arm and the jaw part 3. the jaws of the other, inner pair are implemented as cutter jaws 41 that possess blades 37 that press and cut into the insulation that are attached to the cutter jaws so that they may be removed.

A pull rod 43 that moves longitudinally within the plier body and provides the stripping motion is attached to the cutter jaws 41 and is connected to the second plier arm 7 via the link 9.

Also, a wire cutter 45 to stretch the cable to be stripped is located between the first plier arm 1 and the second plier arm 7. When the plier jaws are closed, the cutter blades of the wire cutter also close, whereby low-effort is enabled by means of the lever action about the lever pivot axis.

The stripping process proceeds as follows: The cable (not shown) is inserted between the gripper jaws 33 so that the desired area to be stripped falls behind the cutter blades 37. Then, as the plier jaws are closed, the second, moveable zg 7 moves toward the first plier arm 1. Thus, pivoting of the jaw part 3 about the pivot point 5 is caused via the link 9 whose one end is attached to the second plier arm 7 and whose other end is attached via the roller 11 to jaw part 3, whereby the plier jaw is closed and the two gripper jaws 33 are pressed firmly against the cable covering. Thus, the cutter jaws 41 are also brought into cutting position as described below in greater detail.

The gripper jaws 33 preferably each include a raised gripper tooth 47 (see Figure 4). This raised gripper tooth 47 and the cutter blade 37 possess one-sided mirror-image angled cutting strips. When the gripper jaws 33 are closed, the hfz 47 cuts into the cable covering, providing additional fixing of the insulation remaining on the cable. The resistance that the gripper jaws 33 encounter at the compressed cable prevents further closing.

Determination of the cutting depth occurs in that, when the plier is further squeezed and the concomitant extension of the jaw part 3 about the pivot point 5, the first sliding wedge 13 is lightly drawn away from the jaw tip. Thus, the first sliding wedge 13 is displaced by an amount that results from the difference in the distances A and B shown in Figures 1 and 2 between the front end of the sliding wedge and the front rest edge in the recess.

This displacement causes the cutter jaws to be closed by the adjustment amount C and simultaneously the angular position of the first sliding wedge 13 from the position E to position D to be changed (see Figure 3).

Simultaneously with this, pivoting of the jaw part 3 results via the second sliding wedge 23 that is attached via the second coupling rod 29 to the first plier arm 1, so that a relative movement of the second sliding wedge 23 with respect to the jaw part 3 in the same direction as for the first sliding wedge 13.

Thus, an adjusting movement of the cutter jaw 41 perpendicular to the longitudinal displacement by the amount C and the positional correction of the second sliding wedge 23 from E to D. Selection of the back radius R of the sliding wedges 13, 23 taken from Figure 3 allows optimization of the adjustment amount C and the positional correction for varying applications.

In the further progression, stripping of insulation from the conductor occurs in that the cutter jaws 37, 39 are drawn via the pull rod 43 toward the center of the plier by the movement of the link 9 against the pull spring 49.

During stripping, a point-shaped arrangement of the cutter jaws 41 arises on the sliding-wedge surfaces 15, 25. This arrangement is realized by means of a first projection 51 on the side of the cutter jaws 41 facing the sliding-wedge surfaces 15, 25. Also, a second projection 53 exists on the same cutter-jaw side. This second projection 53 centers the central setting of the moving cutter jaws 41. For this purpose, a slot 55 is provided in the pull rod 43 so that both cutter jaws 41 may be positioned uniformly against the gripper jaws 33.

In an advantageous embodiment example, a slight obliqueness of the sliding-wedge surfaces 15, 25 is caused by the shape of the second surfaces 17, 27 when the sliding wedges 13, 23 are displaced longitudinally. As the cutter jaws 41 glide along, a minimal opening of the cutter jaws 41 and the attached cutter blade 37 results.

Fig. 4 shows a detailed view of a plier jaw. Each of the gripper jaws 33 includes an raised gripper tooth 47. As Figure 5 shows, the gripper jaws may be implemented as a tap receiver or as two parallel flat columns. A thickening 57 is located on the taps or flat columns that guarantees a clamping in the receiver jaws 59. A height adjustment of the gripper jaws 33 is possible via a set screw 61. This adjustment is usually set at the factory.

Fig. 6 shows that a securing pin 63 serves to secure the position of the sliding wedges 13, 23. The sliding wedges 13, 23 are thus secured against undesired alteration of position by any conceivable load.

**Reference Index List:**

1	erster Zangenarm	first plier arm
3	Backenteil	Jaw part
5	Drehpunkt	pivot point
7	zweiter Zangenarm	second plier arm
8	Schwenkachse	Lever pivot axis
9	Hebel	Link
11	Rolle	Roller
13	erster Gleitkeil	first sliding wedge
15	erste Gleitkeilfläche des ersten Gleitkeils	first sliding-wedge surface of the first sliding wedge
17	zweite Gleitkeilfläche des ersten Gleitkeils	second sliding-wedge surface of the first sliding wedge
19	erste Koppelstange	first coupling rod
21	erster Stift	first pin
23	zweiter Gleitkeil	second sliding wedge
25	erste Gleitkeilfläche des zweiten Gleitkeils	first sliding-wedge surface of the second sliding wedge
27	zweite Gleitkeilfläche des zweiten Gleitkeils	second sliding-wedge surface of the second sliding wedge
29	zweite Koppelstange	second coupling rod
31	zweiter Stift	second pin
33	Greifbacken	Gripper jaw
37	Schneidmesser	Cutter blade
41	Schneidbacken	Cutter jaw
43	Zugstange	Pull rod
45	Drahtschneider	Wire cutter
47	erhöhter Greifzahn	Raised gripper tooth
49	Zusliding-wedge surfaceeeder	Pull spring
51	erste Erhöhung	first projection
53	zweite Erhöhung	second projection

55	Langloch	Slot
57	Verdickung	Thickening
59	Aufnahmebacken	Receiver jaws
61	Druckschraube	Set screw
63	Sicherungsstift	securing pin